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(54) **A method of making a photographic mask**

(57) A method of identifying a contour line or an outline of a picture image is disclosed as part of the process of making a photographic mask. An approximate contour line 9 is first designated manually and by comparing the density or the color phase of each pixel with a certain reference a precise contour line is determined as a boundary at which the result of the comparison reverses. To facilitate the comparing process, a plurality of partial picture image areas is defined along the approximate contour line 9, a respective reference for each such partial area being based on measured densities in that area. The contour lines of two neighboring partial picture image areas are connected either automatically or manually.

FIG. 1

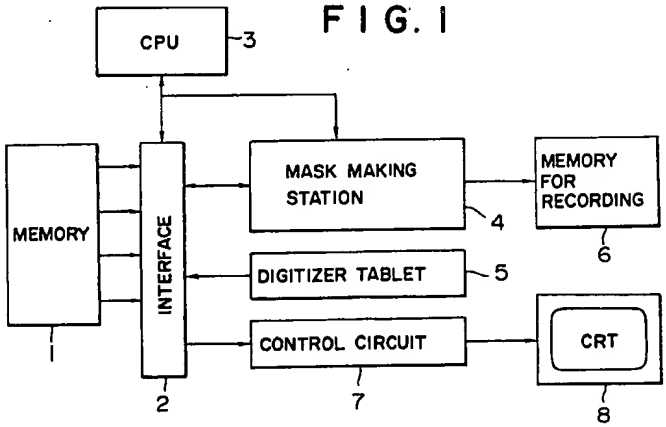

FIG. 2

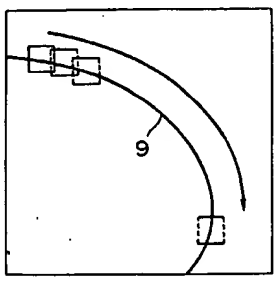

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FIG. 1

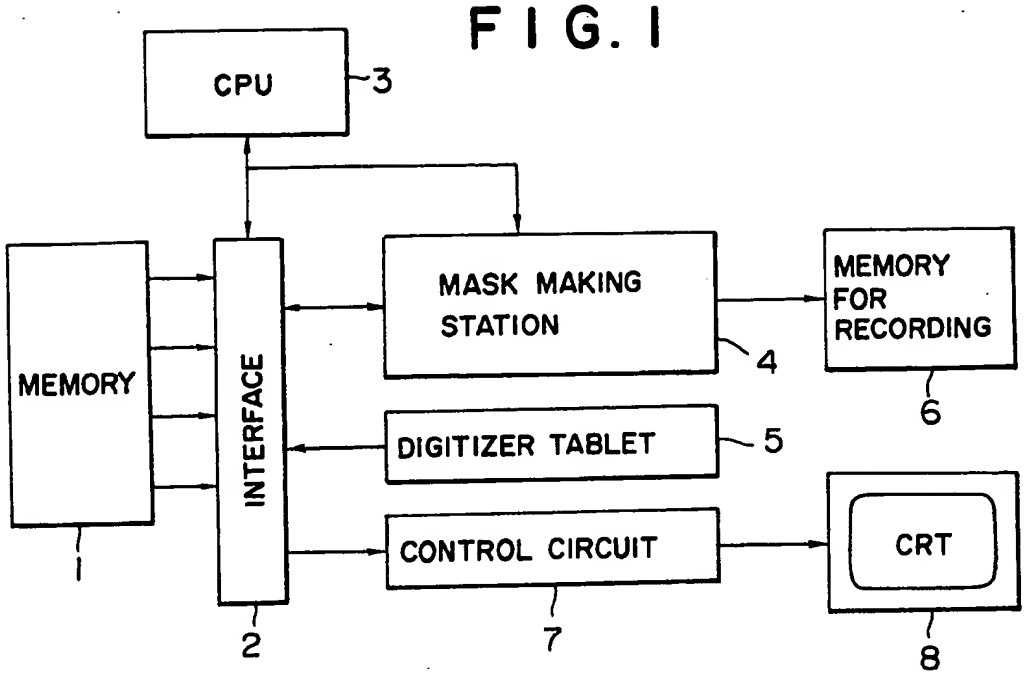


FIG. 2

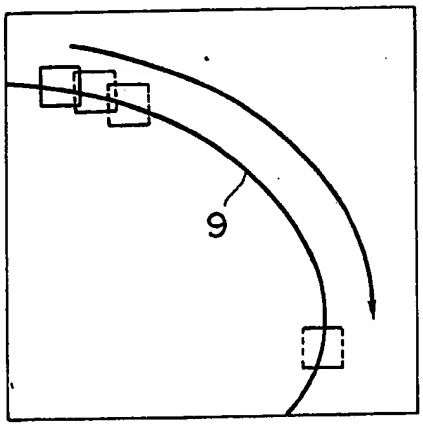
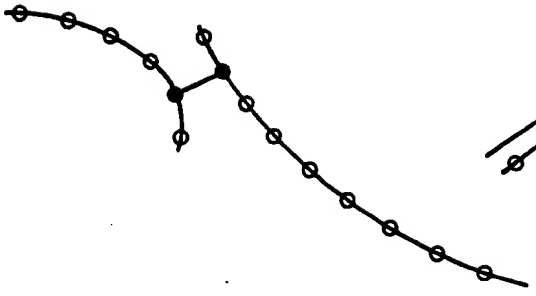


FIG. 3b

FIG. 3a



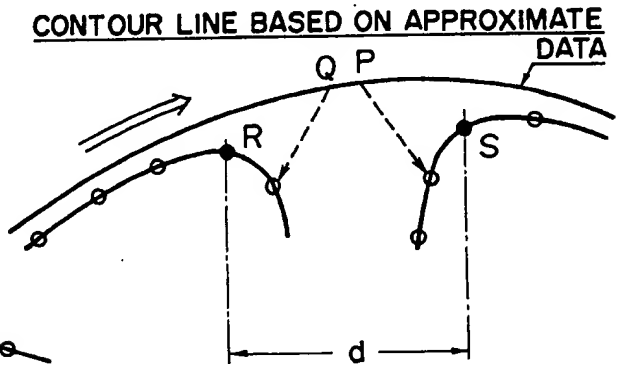


FIG. 4a

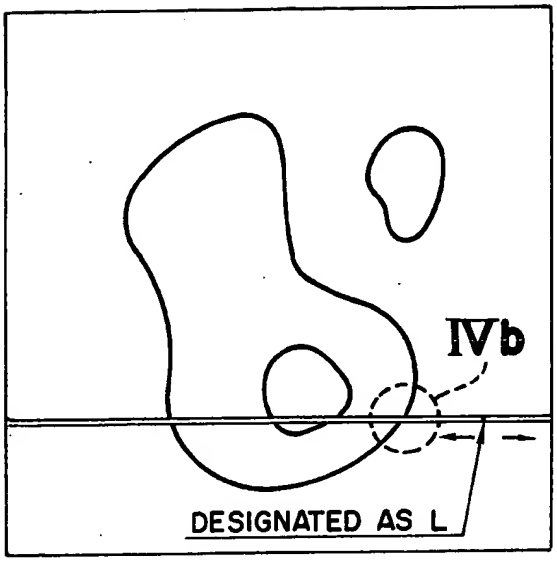


FIG. 4b

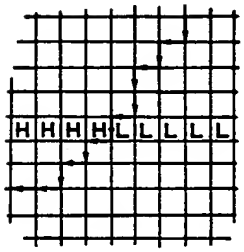


FIG. 4c

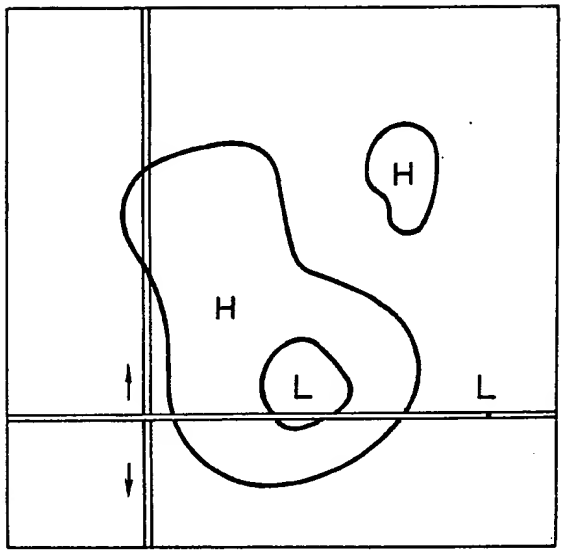
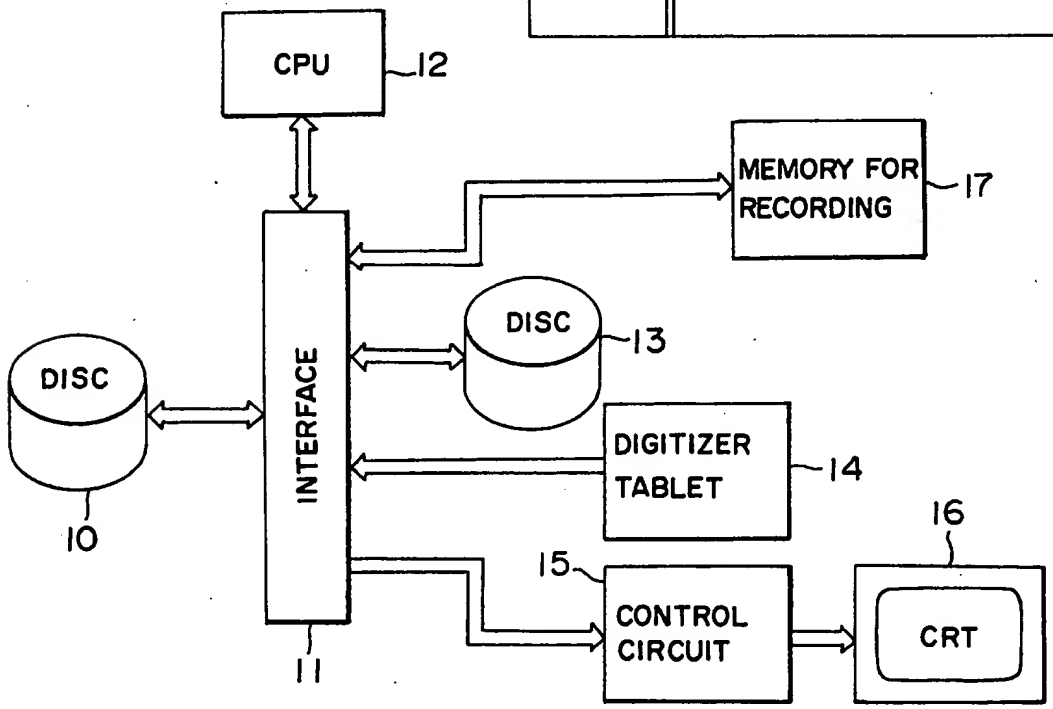


FIG. 5



SPECIFICATION

A method of making a photographic mask

Background of the Invention

This invention relates to a method for tracing or tracking a contour line or outline of an image on a photographic film or the like, or a line in a line image such as a comic movie picture or the like, and recording the image that is identical to the contour line or a line image thus obtained through digitalized image processing techniques and in particular to a method for making a photographic mask.

In printing, masks are used in many ways. For instance, when a cotalog of goods is printed, a photographic picture which is to be used as an original picture generally includes background images around the image of the goods but such background images are normally deleted when the original picture finally appears on the catalog.

Therefore, a reporoduction image is obtained by preparing a film of which the necessary part is transparent and the rest opaque, laying this film on the original picture, and reproducing the combination photographically. Depending on the circumstances, it may be desirable to provide such a mask in which the necessary part is opaque and the rest transparent.

Such a mask has heretofore been made by hand. For instance, in the same manner as when tracing a drawing in industrial drafting, a transparent film is laid on the original picture, and the contour or the outline of the part to be masked is drawn. The outside or the inside of the contour line is then blotted out by opaque ink, to obtain the photographic mask.

This process requires a skill which can be only acquired from experience and is very time consuming, causing it to be a great impediment in photographic plate making process which has otherwise grown to be highly automatized lately. This is particularly the case when the desired contour line is highly irregular or convoluted in shape.

To alleviate such an inconvenience, it is often practiced to directly paint the portion to be masked off on a photographic film of desired size reproduced from the original picture. Alternatively, to save the trouble of painting, a peel-off film may be used but the trouble of tracing the contour line can not be eliminated. In either case, the process requires fine hand work and sufferes from cost and accuracy problems.

Also, when taking an original picture, the photographic conditions are often set up so that the background portion has a certain color tone for the purpose of obtaining a desired photographic mask by extracting or eliminating a certain color from the background: This process is sometimes refered to as chromakey technique. However, since this process requires premeditation when taking the original picture film, it is not widely utilized in printing as far as we know.

Summary of the Invention

In view of such shortcomings of conventional processes for making a photographic mask, a primary object of this invention is to provide a method for making a photographic mask from picture image data in the form of electric data, which is both simple and accurate.

Another object of this invention is provide a method for making a photographic mask which may be conveniently utilized in printing layout pictures or composing a plurality of pictures into a single picture in desired arrangement.

According to this invention, such objects are accomplished by providing a method of making a photographic mask, comprising the steps of

storing data corresponding to an original picture in a memory means,

displaying the original picture image on a display means,

approximately designating a contour line of the original picture image displayed on the display means, in the form of electric data,

defining a plurality of partial picture image areas along the approximate contour line so that the approximate contour line falls substantially on the middle of each of the partial picture image areas, and

extracting a desired contour line by comparing the color separation picture image data of each pixel in each of the partial picture image areas with an average value of the color separation picture image data of all the pixels in the partial picture image area or alternatively by comparing the three color image data of each pixel in each of the partial picture image areas with the three color picture image data of a certain color phase, or by selective utilization of these two types of comparison.

Brief Description of the Drawings

The present invention will be more fully understood from the following description of preferred embodiments thereof, and from the appended strictly non-limiting drawings; in which

Figure 1 is a block diagram of a structure which is adapted to practice the method of this invention;

Figure 2 is a conceptual diagram illustrating a mode of defining partial picture image areas along a contour line;

Figure 3a and *3b* are conceptual diagrams showing two different modes of connecting two mutually separated contour lines which were identified by the method of this invention;

Figure 4a, 4b and *4c* are conceptual diagrams showing a mode of designating each of the pixels in a partial picture image area with either a high or a low level signal; and

Figure 5 is a block diagram of a structure which is adapted to practice another embodiment of the method of this invention.

Description of the Preferred Embodiments

A mask making station 4 for implementing this invention has the functions of storing a picture image comprised of a same or comparable number of display pixels (500 × 500, for instance) as a picture display device, extracting contour lines, connecting contour lines and painting the interior or the exterior

of the contour lines.

The storage function of the mask making station 4 comprises a memory block which can store the signals for at least two color separated plates when using the chromakey technique for extracting contour lines, as will be described later, and the data stored in this memory block may be color displayed on a picture display device 8 as a non-compressed picture image.

Next, the manner of making a photographic mask according to this inventions is described in the following.

On the picture display device 8, the whole picture image is displayed in an appropriately compressed manner from the color separation picture image data of at least one color stored in the memory means 1.

This memory means 17 is written with the picture data which is corrected or not corrected in color, tone gradation and so on after being picked up by a color scanner or the like and its memory capacity is determined by the maximum value of the record size of each specific picture image. For instance, when the number of exposure scan lines of the printing plate which is to be recorded at the size of 20 × 30cm is 200 lines/cm (500 lines/inch), then the memory capacity may be 4K × 6K = 24M bytes.

It is also possible to improve the efficiency of making photographic masks by providing a plurality of such memory means 1 in parallel and using them for making photographic masks alternatingly.

The contour line of the picture image displayed on the picture display device 8 is then roughly traced by moving a cursor of the digitizer 5 while watching the spot image corresponding to the cursor displayed on a monitor screen over the compressed image on the picture display device 8. At the same time, the position of the cursor is appropriately written into the memory of a CPU 3 as an approximate data of the desired contour line.

The CPU 3 also converts the approximate data of the contour line so that it corresponds to the addresses of the memory means 1.

Next, when an actual contour line is to be detected, part of the reporduced picture image corresponding in terms of pixels to the picture image displayed on the picture image display device 8, is read out, for instance, from a C-plate memory device which is written with the picture image signal for a cyan plate, and is stored within the mask making station 4.

This partial picture image is selected so that it contains part of the approximate contour line data approximately at its center and the density of each of the pixels contained in the partial picture image area which is selected so as to contain the approximate contour line and its surrounding is compared with the average density of all the pixels in this partial picture image area, identifying each of the pixels as either H or L depending on the result of the comparison.

Each partial picture image area is normally smaller than the whole frame of the picture image display device 8 but may not be necessarily so.

Such a determination may be conveniently made as an arithmetic process in the CPU 3. The partial picture image area is intermittently moved along the contour line 9 of the approximate data, overlapping those located next to them, as illustrated in Figure 2, and the above-mentioned determination is carried out on each of the pixels within the partial picture image area at each location.

When either H or L is determined for each of the pixels surrounding the contour line of the approximate data in the partial picture image area, the boundary between H and L is traced and the coordinates falling upon such a boundary are obtained as the contour line data of that particular partial picture image area.

Next, another partial picture image area is selected so that the neighboring approximate contour line data falls approximately on its center and the contour line data is obtained with respect to this partial picture image area as well.

As the approximate contour line data is sequentially traced by repeating the above described procedure, all the contour line data is obtained and temporarily stored in a memory device 6 for recording.

When it is difficult to automatically extract the contour line data in extracting the contour line data according to the density value of each pixel because the difference in the brightness of the background and/or the image to be conserved happens to be too small, for instance, on the cyan plate, it is also possible to read out the signals for a magenta, yellow or other color separated plate from the memory means 1. It thus becomes possible to increase the probability of automatically extracting contour line data.

When extracting such contour line data, it is also possible to utilize the chromakey technique as described previously.

In this case, the contour line data is obtained by reading out the density values of the cyan, magenta and yellow plates from the corresponding addresses of the memory means 1 for each of the pixels, comparing the density values of cyan, magenta and yellow colors for each of the pixels, dividing the pixels into those corresponding to a predetermined color phase and those which do not, and tracking the boundary between these two kinds of pixels so that the coordinate values corresponding to this boundary may be extracted.

The contour line data thus extracted for each of the partial picture image areas is so selected as to cover some of the pixels which are covered by the neighboring partial picture image areas.

Therefore, the starting point and the ending point of the contour line data of two neighboring partial picture image area either overlap one another, are slightly displaced from one another, or are totally displaced from one another.

When the starting point and the ending point of the contour line data of two partial picture image areas are overlapping one another, the contour line data of either one of the two nieghboring partial picture image areas may be used as the final contour line data without any need for performing a connecting process.

However, when the starting point and the ending

point of the contour line data of two neighboring partial picture image areas are located relatively close to one another as shown in Figure 3 (a), there is a need to perform a connecting process. The final contour line data is therefore obtained by evaluating the distance between coordinate point groups (denoted by O in Figure 3(a)), detecting the coordinate point pair (denoted by in Figure 3(a)) that give rise to the minimum distance, and connecting these coordinate points.

Furthermore, even when the starting point and the ending point of the contour line data of the neighboring partial picture image areas are located far away from one another as shown in Figure 3(b), it is possible to perform the connecting process.

Specifically, by detecting a coordinate point R which is fairly close to the coordinate point Q at which the current partial picture image area and the contour line of the approximate data intersect and which belongs to the coordinate point group of the contour line data extracted from the previous partial picture image area and is directed substantially along the direction of the contour line of the approximate data, and a coordinate point S which is fairly close to the coordinate point P at which the previous partial picture image area and the contour line of the approximate data intersect and which belongs to the coordinate point group of the contour line data extracted from the current partial picture image area and is directed substantially along the direction of the contour line of the approximate data, and, if the distance d between these coordinate points R and S is sufficiently small, the final coordinate data may be obtained by connecting these coordinate points R and S.

Any omission or error in the contour line data may be corrected manually by displaying the contour line data on the picture image display device 8 along with the corresponding partial image for visual inspection every time the contour line data is extracted from each partial picture image area and one may proceed to the next partial picture image area after all the necessary manual correction is made or immediately thereafter if there is no correction to be made.

When the picture image which is desired to be extracted is so much submerged into the background that the contour line can not be determined even when any of a cyan, a magenta and a yellow plates is utilized, the contour line data can not be normally extracted either by the previously mentioned density determination method or the chromakey method and it is often impossible to connect contour line data together by performing the connecting process.

Specifically, by reading out the whole contour line data extracted and written into the memory device 6 and feeding it into the CPU 3 for analysis, any omission is detected and then the picture image of the cyan plate or the multi-color picture image of the coordinate position corresponding to the omission and the contour line of the portion neighboring the place of omission are displayed on the picture image display device 8. The input of the position is made by tracing the curve corresponding to the place of omission with a cursor attached to the digitizer and displaying it with flicker on the picture image display device and the coordinate data of the place of omission is added and inserted until the correction of the omission is complete. This correcting process may be carried out on all the omission in the contour line data.

Thereafter, the whole image corresponding to the final contour line data is displayed on the picture image display device 8 and may be visually inspected and confirmed.

When any error in extracting the contour line in extracting the contour line data is found, it is possible to detect the coordinate point of the contour line data which is closest to the desired point by moving the cursor attached to a digitizer 5 on the digitizer 5 and inputting the signal from the cursor into the CPU 3 when the cursor input position displayed on the picture image display device 8 has reached a predetermined position in the overall image, and both the original picture image near the detected coordinate point and the contour line image corresponding to the contour line data are displayed on the picture image display device 8. Therefore, the correction of this particular point may be carried out in the same way as the previously described correcting process of omissions.

When the closed contour line of the image corresponding to the desired photographic mask is extracted, then the mask is painted at the photographic mask making station 4 by distinguishing those pixels inside or outside the contour line with a signal, such as high level signal "H" or "L" and so on.

An example of such a painting process is shown in Figure 4-a to 4-c.

After the closed contour line is extracted, a pixel which is clearly inside or outside the contour line is designated with either L or H as shown in Figure 4-a. When only the distinction between inside and outside of the contour line is required and it is needless to know whether the inside is H or L, the process may be started from an arbitrary point without any need for designating it specifically.

Then, the pixels are picked up one by one along the horizontal direction until the contour line is reached and these pixels are designated with the same designation H or L as the one which was initially selected. When a contour line is crossed over, the designation is reversed by replacing H with L or L with H as shown in Figure 4-b until the next contour line is crossed over or a side end of the picture frame is reached.

When the designation of one horizontal line with H and/or L is completed, the pixels are picked up one by one along a vertical line from every pixel on the previously designated horizontal line and are designated with the same designation H or L depending on the designation of the first pixels on the horizontal line until a contour line located above or below is reached, and once a contour line is crossed over, the designation is reversed by replacing H with L or L with H as the case may be.

And this process is continued until each of the vertical line runs into the upper and the lower ends of the picture frame.

The whole picture frame may thus be desingated with H's and L's.

In the above-described process also, it is desirable to check the result by monitoring the whole picture image.

The data for the painted photographic mask is finally written into the memory device 6 for recording.

The above-mentioned photographic mask making station as a station exclusively for cutting out a photographic mask may also be applied to a layout system for recording reproduced pictures corresponding to a plurality of original pictures on a single sheet of output film at desired magnification factors and in desired arrangement.

In this case, for instance, the following two cases are conceivable. One is the case in which a separate station exclusively for cutting out a photographic mask is applied to a layout system and the other is the case in which the photographic mask making station according to this invention is incorporated into a layout station (which may have the functions of picture image composition, additive correction and so on).

Figure 5 is a block diagram showing an example of the latter or a layout system to which the photographic mask making station according to this invention is applied.

In Figure 5, numeral 10 denotes a magnetic disc memory device into which a digital picture Image signal corresponding to a plurality of original pictures is written as a color plate signal corresponding to the ink of Y, M, C and K after receiving color correction, gradation correction and so on and being magnified to a desired factor, numeral 11 denotes an interface, numeral 12 denotes a central processing unit (CPU) which may, consist of, for instance, a microcomputer equipped with a necessary processing program, numeral 13 denotes a magnetic disc memory device into which the picture image signal is finally written after being layout-processed, numeral 14 denotes a digitizer tablet, numeral 15 denotes a control circuit for a picture image display device 16 such as a CRT, and numeral 17 denotes a photographic mask making station having functions equivalent to those of the previously mentioned one.

In this layout system, a set of finish dimensions are designated and a user area is set aside in the magnetic disc memory device 13, and then the designated dimentions are accurately assigned to each picture image data corresponding to each of the original pictures according to an initially defined layout usIng te digitizer tablet 14 and the picture image data which is to be finally layout-processed is written into the corresponding addresses of the magnetic disc memory device 19 after the CPU has performed the necessary transformation of the coordinates into the positions designated for the finish.

In this conjunction, It is also possible to prepare the picture image data corresponding to the desired photographic mask with the photographic mask making means 17 at each time for a layout process such as trimming. It is also possible to read out the picture image data corresponding to the desired photographic mask made in advance by the photographic mask making station 17 from a memory device not shown in the drawins and to utilize it for application.

When all the picture image data that is required for the finish is written into the magnetic disc memory 13, the picture image data is written into the appropriate places of the areas of the magnetic disc memory device 13 corresponding to the dimensions of the finish at the scan line density at the time of exposure, at designated dimensions and in designated places.

Hence, when outputting picture images onto photographic film or the like, the reporduction picture image is recorded at a desired layout and at a desired magnification factor simply by outputting the picture image data written into the magnetic disc memory device.

Also, the method of this invention may be applied not only to such a layout system also to a simple layout scanner, a so-called composing scanner. Reference is made to commonly owned US Patent 4,327,380 (DE-OS 3031483) which specifically discloses such a composing scanner.

A composing scanner detects the positional deviation of a scanning head which photoelectrically scans an original picture and a recording head for recording a reproduction picture, for instance, of a drum type scanner, with respect to the position of the recording head which is fed at a constant speed along a secondary scanning direction, from the starting points of the photoelectrical scanning of the original picture image and the recording of the reproduction picture image, respectively, and, based on the positional deviations thus found and the magnification factor of each of the reproduced picture images, reproduces the desired picture image at a desired magnification factor on desired positions on real time basis, and the method of this invention is applicable to such a device as well.

Specifically, by preparing, in advance, picture image data corresponding to a photographic mask with its necessary part painted out or blotted out according to this invention, writing this data into a memory device, and controlling a picture image signal read by a scanning head according to the picture image data corresponding to the photographic mask, it is possible to record a reproduction picture image that is trimmed to a desired configuration at a desired magnification factor and in a desired arrangement.

And it goes without saying that the method of this invention may be applied to photographically recording of a photographic mask image as a device exclusively for making a photographic mask as well as to an utilization in a separate picture image processing system as described previously by writing the picture image data corresponding to a photographic mask into a memory device in advance.

As described above, according to this invention, the work efficiency is high since an operator does not have to accurately trace an actual contour line when he specifies the approximate contour line along the actual contour line and the tracing of the approximate contour line can be quickly made

without causing any substantial fatique to the operator. Furthermore, since the operator is only required to input necessary data on a dialog basis with regard to only the part of the work which requires human judgement, the processing work can be substantially automatized and photographic masks may be produced efficiently and in short time.

Since the photographic mask thus made have the same order of resolution as a color scanner has and the extraction of a contour line is possible either with the density determination method or with the chromakey method, a variety of advantages are offered, such as that an efficient determination processing method may be selected depending on the configuration of the picture image defining the contour line and so on.

Although the present invention has been described with reference to preferred embodiments, a person skilled in the art will recognize that changes may be made in form and detail without departing from the spirit and scope of this invention.

CLAIMS

1. In a method of making a photographic mask, the improvement comprising the steps of:

storing data corresponding to an original picture in a memory means;

displaying the original picture image on a display means;

approximately designating a contour line of the original picture image displayed on the display means, in the form of electric data;

defining at least one partial picture image area along the approximate contour line so that the approximate contour line falls substantially on the middle of the partial picture image area; and

extracting a desired contour line by comparing the color separation picture image data of each pixel in the partial picture image area with an average value of the color separation picture image data of all the pixels in the partial picture image area.

2. In a method of amking a photographic mask, the improvement comprising the steps of:

storing data corresponding to an original picture in a memory means;

displaying the original picture image on a display means;

approximately designating a contour line of the original picture image displayed on the display means, in the form of electric data;

defining at least one partial picture image area along the approximate contour line so that the approximate contour line falls substantially on the middle of the partial picture image area; and

extracting a desired contour line by comparing the three color picture image data of each pixel in the partial picture image area with the three color picture image data of a certain color phase.

3. In a method of making a photographic mask, the improvement comprising the steps of;

storing data corresponding to an original picture in a memory means;

displaying the original picture image on a display means;

approximately designating a contour line of the original picture image displayed on the display means, in the form of electric data;

defining at least one partial picture image area along the approximate contour line so that the approximate contour line falls substantially on the middel of each of the partial picture image area; and

extracting a desired contour line by comparing, selectively, either the color separation picture image data of each pixel in the partial picture image area with an average value of the color separation picture image data of all the pixels in the partial picture image area or the three color picture image data of each pixel in the partial picture image area with the three color picture image data of a certain color phase.

4. A method of making a photographic mask according to claim 3, wherein both the data corresponding to the original picture and the data corresponding to the approximate contour line are digital values, and the approximate contour line is designated manually with the aid of a digitizer tablet.

5. A method of making a photographic mask according to claim 4, wherein the partial picture image areas are so defined that each two neighboring partial picture image areas have some overlapping.

6. A method of making a photographic mask according to claim 5, wherein the comparing process is made by designating each of the pixels with either a high level signal or a low level signal.

7. A method of making a photographic mask according to claim 6, wherein the contour line identified in each of the partial picture image areas is simply connected to the contour line identified in the next partial picture image areas whenever possible while, when there is a discrepancy between the contour lines of two neighboring partial picture image areas, a supplementary contour line is identified by connecting two pixels lying on the respective contour lines which define the shortest distance between them of all the combination of two pixels lying on the respective contour lines.

8. A method of making a photographic mask according to claim 7, wherein the deficiency in the contour line identification is corrected by an interaction between a display means displaying the overall picture Image with the identified contour line superimposed thereon and a human operator operating a digitizer connected to the memory storing the contour line data.

9. A method of making a photographic mask, according to cliam 8, wherein the painting process is initiated by selecting a point, and then proceeding to the next pixels along the horizontal direction and, from each pixel on the horizontal line, to the next pixels along the vertical lines, and each of the pixels in the whole picture frame is painted depending on the designation of the pixel with either high or low level.

10. A method of making a photographic mask substantially as herein described with reference to the accompanying drawings.

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